



Reduce Incidence of **B**abies with **BrON**chopulmonary Dysplasia (**RIBBON**)

A joint collaboration between Neonatology and Obstetrics
Teams

14 to 17 Mar 2023 (3.5-day)

Project Title 1 : Reduce Incidence of Babies with BRONchopulmonary Dysplasia (RIBBON)

Department: Neonatology, O & G
 Sponsors (HODs): A/Prof Zubair Amin, (Neonatology), A/Prof Mahesh A Choolani (O & G), ADON Sarah Ho-Lim

Period: Mar '23 to Dec '23
 Facilitators, Team Leaders & Members: See next page



1. Reason for Action

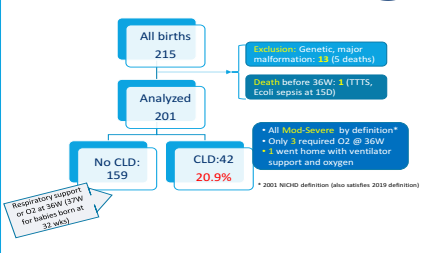
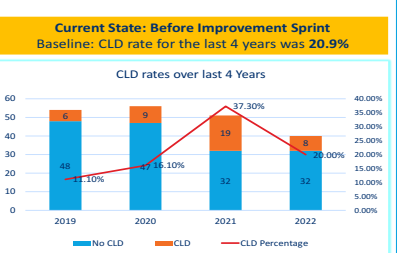
In NUH, Bronchopulmonary Dysplasia (BPD) has increased over the last 11 years, markedly so since 2020. For all babies (23-31 weeks), BPD incidence increased from 30% to 67%; 23-27 weeks 50-60% to 85%; 28-31 weeks 10-15% to 60%. ANZNN 2017-2019 BPD rate in 23-27 weeks babies* was 63.6%.

BPD is Chronic Lung Disease (CLD) of prematurity, where babies still require supplemental oxygen or respiratory support at 36 weeks post menstrual age. BPD evolves with time, and babies who will have more severe BPD are usually identified during the course of the neonatal ICU stay based on duration of invasive ventilation, duration of non-invasive bi-level respiratory support and chest X-ray findings. These babies may already be at higher risk of BPD based on non-modifiable factors such as gestation and weight at birth, and severity of respiratory distress syndrome (RDS) at birth.

Therefore, the team would like to examine the current workflows and pathways to identify gaps and areas to strengthen the processes from antenatal to postnatal.

In-scope:
 Antenatal → Delivery → Postnatal
 Start: Antenatal @ 23 weeks
 End: Postnatal 36 weeks (post-menstrual age) for all babies and 37 weeks for 32 weeker

2. Initial State



3. Target State

Improve Patient Outcome
 To reduce the incidence of CLD from **20.9% to 15%** (↓28%) by 1st qtr of 2024 and to **10%** (↓52%) by 1st qtr in 2025 in babies born between 28 and 32 weeks completed gestation.

4. Problem Analysis

Tools used as follows (refer to next few slides for details)

- ✓ Current VSM (Antenatal, Delivery & Post 1 week)
- ✓ 3 RCAs to analyze the following Gaps
 - Sub-optimal growth & nutrition
 - Sub-optimal respiratory care
 - Sub-optimal foetal state
- ✓ Paradigm Breaking Exercise

5. Solution Approach

Tools used as follows (refer to next few slides for details)

- ✓ Lean solutions
- ✓ Best practices
- ✓ Future VSM (Antenatal, Delivery & Post 1 week)

6. Rapid Experiment and Prototyping

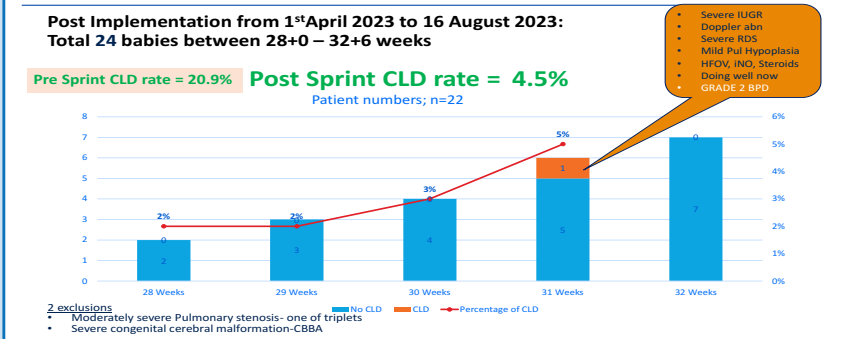
The following standard works were derived during the improvement sprint.

Item	Description	Icon
1	Rational antenatal corticosteroid administration	📄
2	Nutrition proposal	🍽️
3	LISA	👤
4	Nursing Practice (BPD)	👩
5	Physiologic Assessment of BPD	👩
6	Ribbon Card, Daily Documentation Template, Golden Hour refinements	📄
7	Summary of Standard Work	📄

7. Completion Plan

7. Completion Plan (phase 1, 30 Apr)				7. Completion Plan (Longer term)			
SN	Item	Who	When	SN	Item	Who	When
1	Standardized Nutrition Plan	Dr Kalia, Dr Jawahar, Dr Khatib, Dr Lee YF	Phase 1 (28 April 2023) Feedback Implementation 15 May	17	FOURCAST (Pre-eclampsia, SGA, Cervical length) Data reporting of gestation	Dr Prady, Dr Sarah, Prof Mahesh	To follow up in 2024
2	Ribbon Card	Dr Khatib, Saravati	Phase 1	18	Increase trained golden hour staff	Dr Khatib, Dr Amutha, Sister Wang Ma, Meena	To follow up in 2024
3	Verification protocol	Dr Agni, Prof Lee, Meena	Phase 1	19	Doctor and nurses to be trained on ventilation support	Meena, Dr Khatib, Saravati, Dr Agni	Phase 2 (July)
4	Nursing protocol	Sister Wang Ma, Meena Chen	Phase 1	20	Early BPD prediction	Dr Agni, Dr Khatib	To follow up in 2024
5	BPD Surveillance	Dr Jawahar, Dr Khatib, Saravati	Phase 1	21	Vitamin A supplementation	Dr Agni, Dr Khatib	To follow up in 2024
6	Feeder tube protocol	Dr Agni, Meena, Meena	Phase 1	22	Urea plasma screening and treatment	All full time members	Physical meeting across UH&STB wards Friday, 14 March, 11.30-1pm (100-200)
7	Nursing care	Sister Wang Ma, Meena, Saha	Phase 1	23	CPAP/Non-Intubating CP (ventilator care)	All full time members	Friday, 14 April, 11.30-1pm (100-200)
8	Golden hour	Dr Khatib, Dr Kalia, Dr Amutha, Meena, Saravati	Phase 1	24	2nd Review Meeting (2 weeks post RIE)	All full time members	Friday, 14 April, 11.30-1pm (100-200)
9	Physiologic assessment	Dr Agni, Saha, Meena, Meena	Phase 1				

8. Confirmed State



9. Insights (Feedback from the team)

What went well?

Brainstorming was superb with excellent ideas	Learned new concepts	Well-fed with brain food	Big charts with constant easy visibility & excellent facilitation	Well organized
Very high yield output	Every points are taken seriously	Very active participation by all members	Active discussions	Great conversations
Great teamwork!	Open & honest	Team dynamics	Cohesiveness	Respect

What could be better?

Protected time post RIE	Talk one at a time
Provide water	Time management

Other insights: Open to change, Cheerful and helpful facilitators (5 & 6), Very friendly team, Nice food and very well fed!

Reduce Incidences of Babies with BrONchopulmonary Dysplasia (RIBBON)

Sponsors:

1. A/Prof Zubair Amin, Chief (Neonatology)
2. A/Prof Mahesh A Choolani, Head Chief (O&G)
3. ADON Sarah Ho-Lim, Assistant Director of Nursing (Neonatology & O & G)

QI & MA Sponsors:

1. Roy Ngong,
Assistant Chief Operating Officer (Plans & Strategy)
Corporate Planning & Development & Quality Improvement
2. Dr Bhuvaneshwari Mohankumar, Head, Medical Affairs (Clinical Governance)

Facilitators:

1. Stacy Leong, Manager (Quality Improvement),
2. Sangeetha Guruvayurappan, Assistant Manager, Medical Affairs (Clinical Governance)

Invitees:

1. Dr. Poon Woei Bing, Head of Neonatology (SGH)
2. Dr. Priyantha Edison, Staff Physician (SGH)
3. Dr. Lee Jiun, Senior Consultant (Neonatology)
4. Dr. Chinnadurai Amutha, Senior Consultant (Neonatology)
5. Dr. Krishnamoorthy Niduvaje, Senior Consultant (Neonatology)
6. Dr. Anita Sugam Kale, Senior Consultant (O&G)
7. Dr. Diana Santos, Assistant Director (MACG)
8. Ms. Lee Soke Yee, Senior Nurse Clinician (Ward 24)
9. Ms. Charlotte Lin, Principal Dietician (Dietetics)
10. Ms. Wong Chui Ying, Senior Dietician (Dietetics)
11. Mr. David Leong, Manager (QI)

Team Leader:

1. Dr. Agnihotri Biswas, Senior Consultant (Neonatology)
2. Dr. Khadijah Binti Abdul Kader, Associate Consultant (Neonatology)
3. Ms. Wang Xia, Nurse Clinician (Ward 24)

Members:

4. Dr. Jeanette Lek, Clinical Associate (Neonatology)
5. Dr. Pradip Dashraath, Associate Consultant (O&G)
6. Dr. Kalaimathy Veerappan (Senior Resident Physician)
7. Ms. Allelieh Capistrano, Respiratory Therapist (Neonatology)
8. Ms. Zhang Suhe, Senior Nurse Clinician, Advanced Nurse Practitioner (Neonatology)
9. Ms. Illene Chen Yi Ling, Senior Staff Nurse (Ward 29)
10. Ms. Sarasvati A/p Rajoo, Senior Staff Nurse (Ward 24)
11. Ms. Melissa Madu Pal, Senior Staff Nurse (Ward 24)
12. Ms. Nicole Chan, Staff Nurse (Ward 24)
13. Ms. Siti Ihdinaa, Nurse Clinician (Ward 22)

1. Reason for Action

In NUH, **Bronchopulmonary Dysplasia (BPD)** has increased over the last 11 years, markedly so since 2020. For all babies (23-31 weeks), BPD incidence increased from 30% to 67%; 23-27 weeks 50-60% to 85%; 28-31 weeks 10-15% to 60%. ANZNN 2017-2019 BPD rate in 23-27 weeks babies' was 63.6%.

BPD is Chronic Lung Disease (CLD) of prematurity, where babies still require supplemental oxygen or respiratory support at 36 weeks post menstrual age. BPD evolves with time, and babies who will have more severe BPD are usually identified during the course of the neonatal ICU stay based on duration of invasive ventilation, duration of non-invasive bi-level respiratory support and chest X-ray findings. These babies may already be at higher risk of BPD based on non-modifiable factors such as gestation and weight at birth, and severity of respiratory distress syndrome (RDS) at birth.

Therefore, the team would like to examine the current workflows and pathways to identify gaps and areas to strengthen the processes from antenatal to postnatal.

In-scope:

Antenatal → Delivery → Postnatal

Start: Antenatal @ 23 weeks

End: Postnatal 36 weeks (post-menstrual age) for all babies and 37 weeks for 32 weeker

What does BPD/CLD look like

Neonate with chronic respiratory distress

Chronic respiratory / O₂ support which tends to improve

Hemodynamic disturbance – pulmonary hypertension

Growth failure

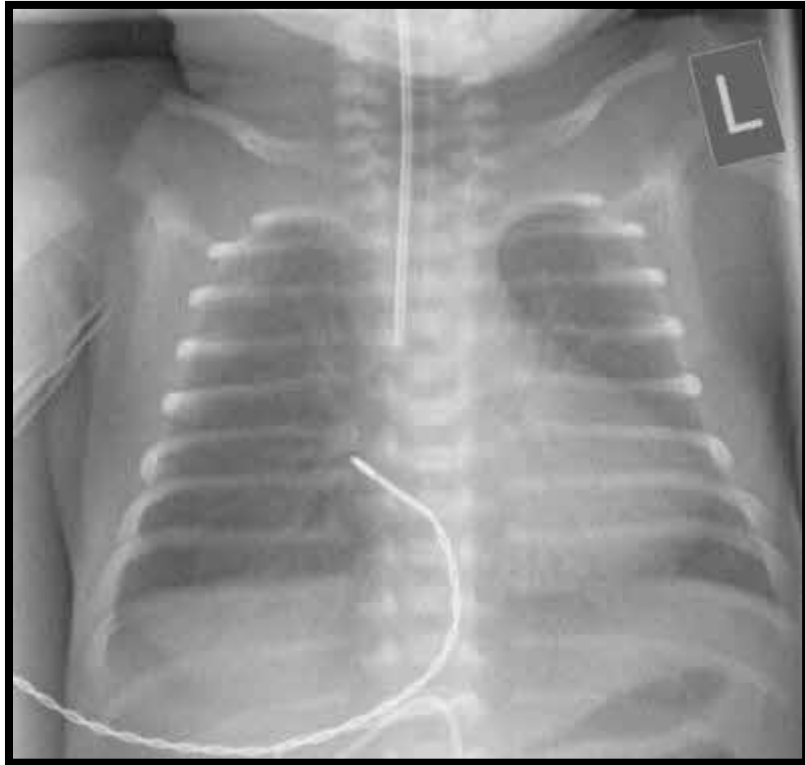
Maturational delay

Strong association with later neurodevelopmental issues

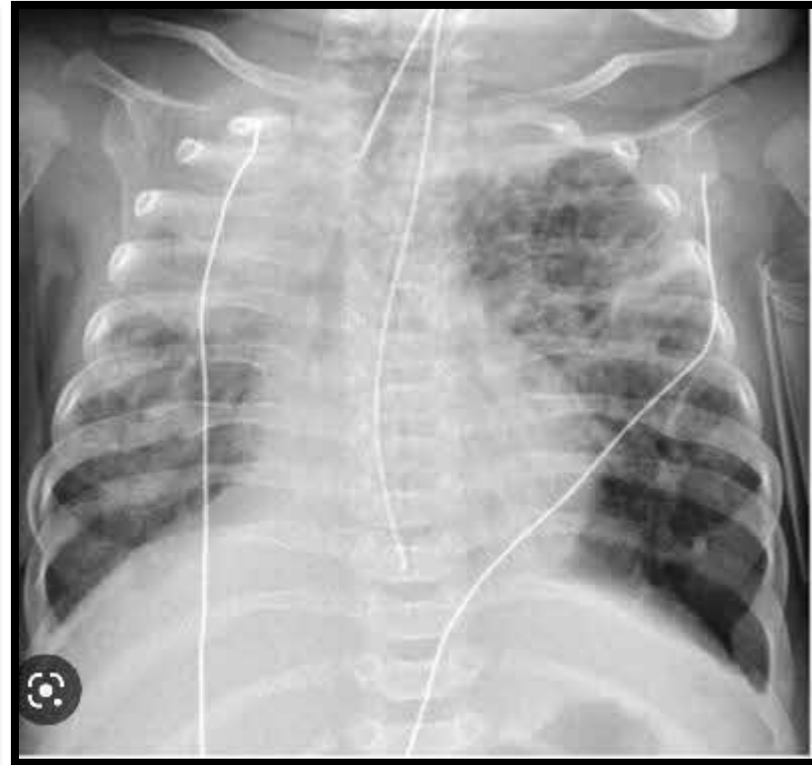
Long term chronic pulmonary issues

Sometimes death

BPD/CLD – Xrays – it's a spectrum



Mild



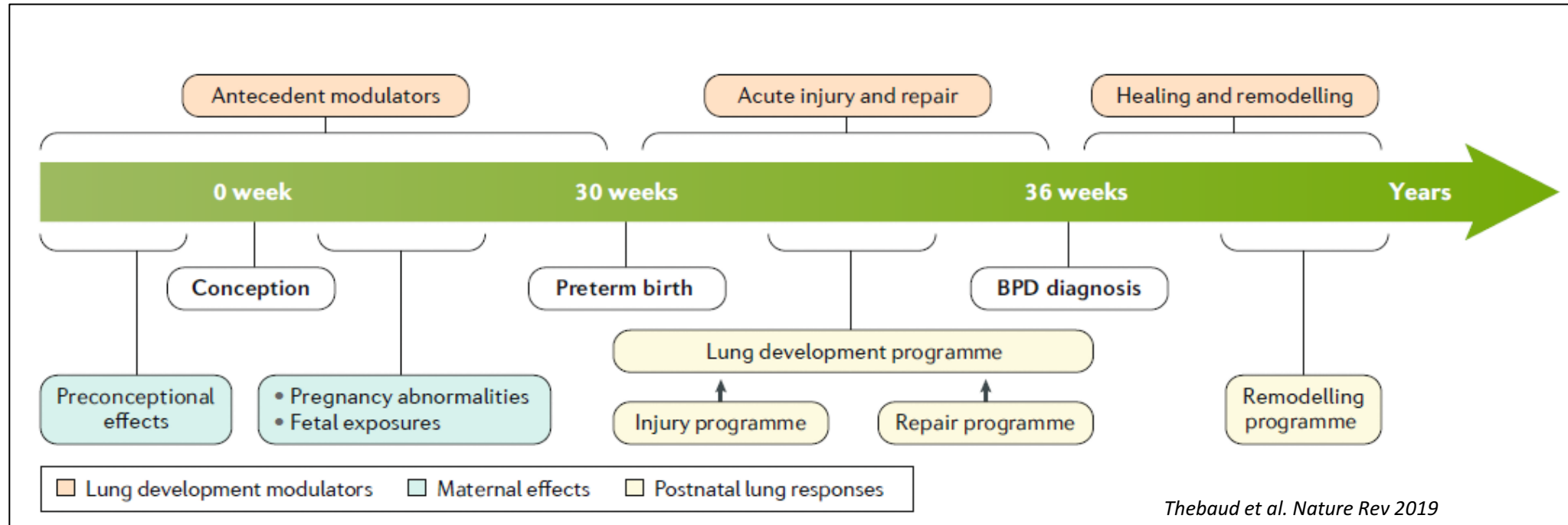
Severe

Definition of BPD

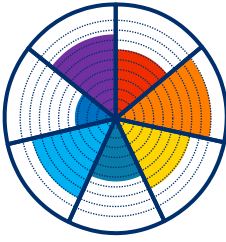
Author and Year	Definition
Shennan et al, 1988 ¹⁴⁶	Use of supplemental oxygen at 36 weeks PMA
NIH consensus, 2001 ¹⁴⁷	Oxygen use for 28 days (not consecutive), with severity based on amount of supplemental oxygen and mode of respiratory support at 36 weeks PMA; mild (room air), moderate (<30% supplemental oxygen), severe (≥30% supplemental oxygen and/or positive pressure)
Walsh et al, 2004 ¹⁴⁸	Receipt of positive pressure or supplemental oxygen at 36 weeks PMA. In infants receiving ≤ 30% oxygen via hood or nasal cannula, a stepwise room air challenge test is performed. Failure of the room air challenge, or need for mechanical ventilation and/or positive pressure are classified as BPD
Isayama et al, 2017 ¹⁴⁹	Use of oxygen and/or respiratory support (including invasive and non-invasive support) at 40 weeks PMA
NICHD workshop, 2018	Supplemental oxygen or positive pressure at 36 weeks PMA along with radiographic evidence of parenchymal lung disease, irrespective of prior duration of oxygen supplementation. Incorporates 3 grades of severity depending on levels of supplemental oxygen and mode of support ¹⁵⁰
Jensen et al, 2019 ¹⁵¹	Any respiratory support at 36 weeks PMA, irrespective of prior duration or current level of oxygen therapy. Further categorized according to disease severity: grade 1, nasal cannula at flow rates ≤2L/min; grade 2, nasal cannula at flow rates >2L/min or non-invasive positive airway pressure; and grade 3, invasive mechanical ventilation

BPD: Bronchopulmonary Dysplasia aka CLD: Chronic Lung disease

It is a clinical expression of the process, in which injured premature lungs repair and remodel over years

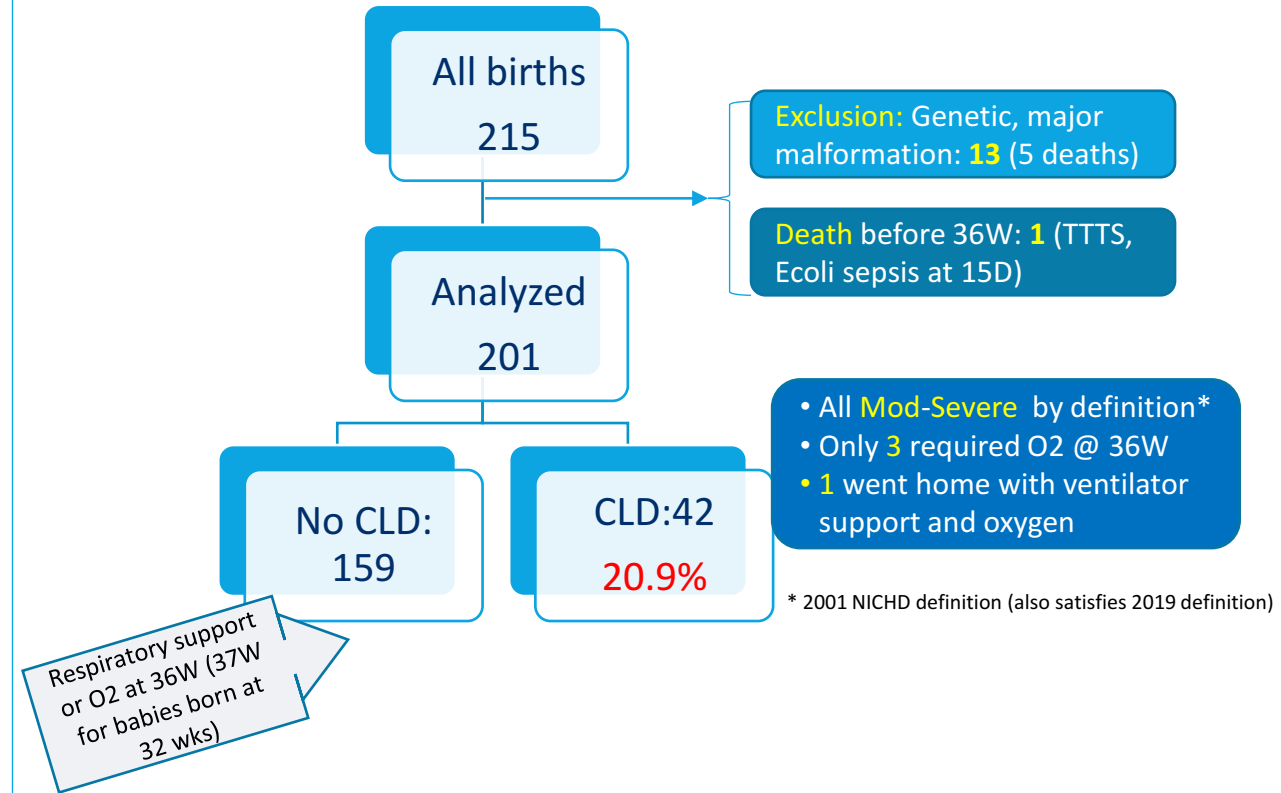
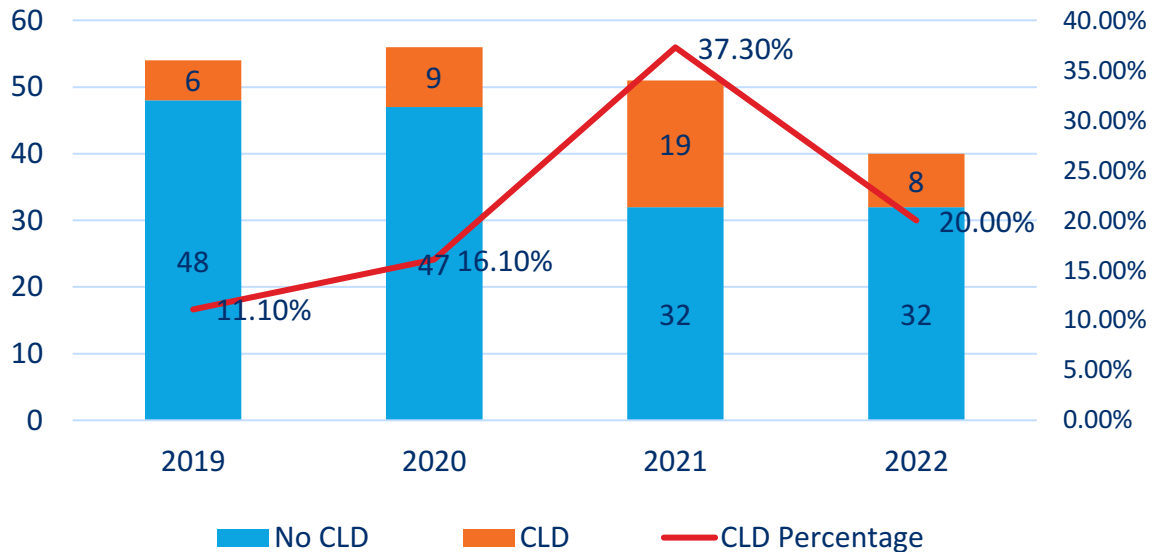


2. Initial State



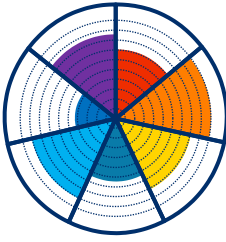
Current State: Before Improvement Sprint
 Baseline: CLD rate for the last 4 years was **20.9%**

CLD rates over last 4 Years



* 2001 NICHD definition (also satisfies 2019 definition)

3. Target State



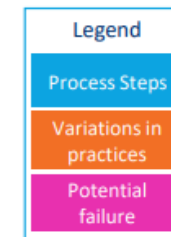
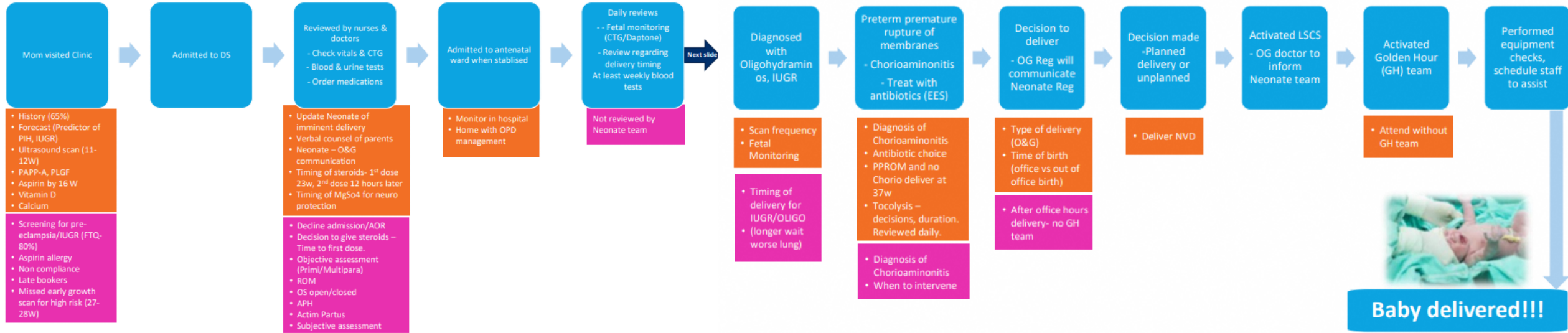
Improve Patient Outcome

To reduce the incidence of CLD from **20.9%** to **15%**
(↓**28%**) by 1st qtr of 2024
and to **10%** (↓**52%**) by 1st qtr in 2025
in babies born between **28 and 32 weeks** completed
gestation.

4a. Problem Analysis (PLAN) Value Stream Map

Current Value Stream Map – Antenatal (1)

Current Value Stream Map – Antenatal (2)



Scope of the workshop

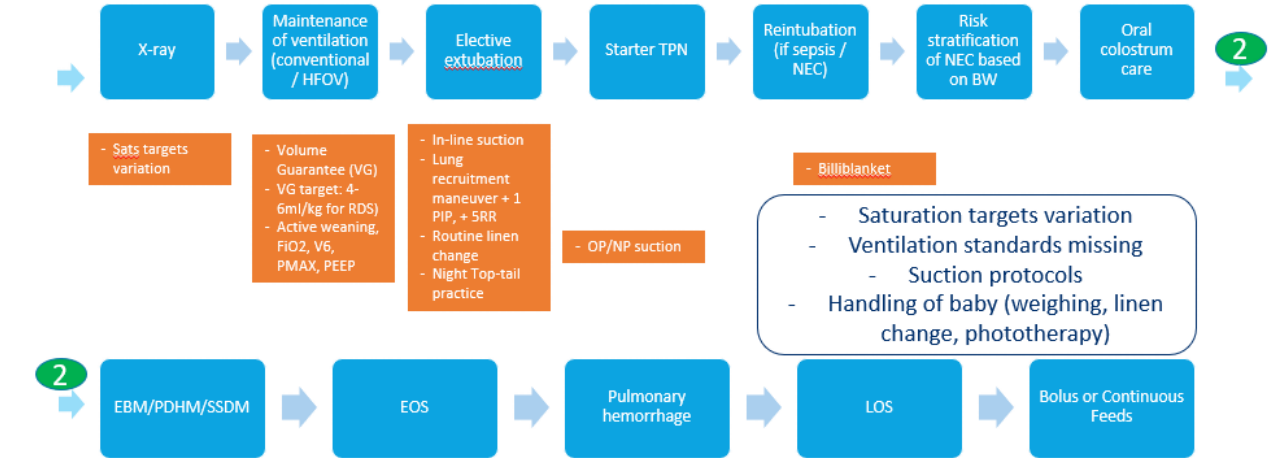
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4b. Problem Analysis (PLAN) Value Stream Map

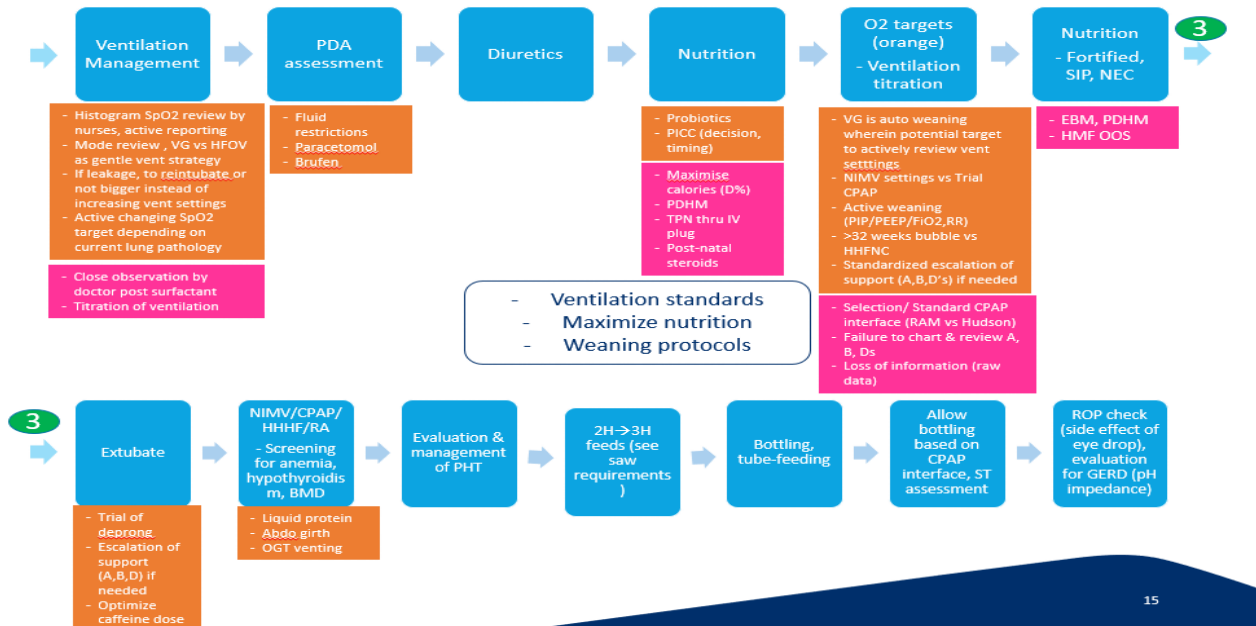
Current Value Stream Map – Birth to 1 HOL



Current Value Stream Map – 1st Hour onwards (2)



Current Value Stream Map – Week 1 onwards (3)



Legend

- Process Steps
- Variations in practices
- Potential failure

Scope of the workshop

- Start: Antenatal @ 23 weeks
- End: Postnatal 36 weeks (post-menstrual age) for all babies and 37 weeks for 32 weeker

4C. Problem Analysis (PLAN) Gap Analysis

3 RCAs were done to analyze the following Gaps,

1. Sub-optimal growth & nutrition
2. Sub-optimal respiratory care
3. Sub-optimal foetal state

Gap Analysis: Sub-optimal Growth & Nutrition

S/n	Issues	Root Causes	Solutions / Interventions
1	Prolong PDHM use	Low EBM supply	--
		PDHM easily available	Chargeable PDHM
2	Prolong bottle feeding (duration/feed)	Lack of support (husbands /LCs)	Improve parental counselling Drs & LCs
		Concern of aspiration?	Evidence required
3	Nutritional loss	No NNS guideline	Create NNS guideline
		Feeding intolerance /reflux	Timely review of feeding method
4	Parental nutrition not optimize	Slower feeding increment as fear of NEC	Review of HGT /micro nutrients threshold
		Concern of hyperglycaemia	Early PICC /central lines
5	Delay in recognising poor growth	Can't optimize macro nutrients in TPN	Nutritional intake as daily vital signs
		No routine review of growth data	Drs to calculate Kcal/kg/day + protein
		Prioritization of other issue	Excel spreadsheet to auto calculate
		High nursing workload	Revise weighing protocol
6	Delay in milk supplement	Compromise respiratory status	once /week dietician review
		Lack of guideline for liquid protein and how to achieve nutritional optimisation	Dietician education for nurses and Drs
		Lack of nutritional round. No dieticians support.	

Gap Analysis: Sub-optimal Respiratory Care

s/n	Issues	Root Causes	Solutions / Interventions
1	No early diagnosis	Lack of skills & training among doctors & nurses	Lung ultrasound at 1 HOL (NN core & RT)
2	No standard ventilation strategy in NNU	No regular meeting between nurses and doctors	Time set aside for clinical issues dissemination during department meetings
		No VG protocol (limitations & troubleshooting)	VG protocol – team to ensure compliance
3	Lung decruitment because of vent. disconnected		
4	No Lisa	No available curosurf	Upload Lisa protocol
			Awaiting curosurf from pharmacy
5	No standard weaning strategy	No milestone	Conduct training of Lisa for nurses & Drs
			Gold card
6	Delay in debronging	Inadequate objective insight on baby's readiness	BPD prediction @ D7
			Focus on baby at high risk
7	No extubation readiness assessment	No milestone	Visuals in multi-disp corner 24 for checklist
			Objective radiological assessment at 2 weeks before CLD diagnosis
8	Sub optimal PDA management	Protocol for PDA tx not enforced	Objective physiological assessment 2 weeks before 36/37 week
			Reuse & optimise caffeine dose every week
9	No consistent care provider	Nursing shift discontinuity	Identify nurse for GWR
			Golden card
10	No full first responder team present	Out of office hour delivery	Extubation checklist
			Chronic lung review template
			Longer duration of rotation for Drs
			Continuity for same baby (Primary nurse); Adopt a baby concept
			More standardized training for team leader
			Give more training opportunity for nurses
			Nurses to be included in mock care
			Pre-briefing & team allocation to allow GH consultants
			Every nurses must be equipped to be PR by training them

4d. Problem Analysis (PLAN) Gap Analysis

Gap Analysis: Sub-optimal Foetal State

SN	Issues	Root cause	Solution/Intervention
1	Poor identification of patients with Pre-eclampsia/IUGR	FORECAST is not part of SOP	Create SOP Preterm foetal group (NUWOC) – work in progress
2	Poor identification of patients with Pre-Term Labour	Lack of resources to do cervical length monitoring – Ultrasound, trained personnel, cost	Create SOP Preterm group – work in progress
3	Suboptimal timing of Antenatal Steroids (ANS)	Current SOP is too general Guidelines to give ANS not clear	Revise SOP and disseminate information Timing of ANS Actim partus
4	Rescue steroids not given	Evidence conflicting	-
5	Patient's non compliance to admission/ medications	Not enough support- MSW, WEHS, O&G and Neonates	Ensure patients are referred to MSW, WEHS for support and constant communications. Inpatient workflow
6	Suboptimal recognition of subclinical chorioamnionitis	No established parameters for clinical infection	-
7	Aspirin not given when indicated	Option to desensitize patients to aspirin not disseminated.	Actively refer patients to desensitization clinic.

Gap Analysis: Sub-optimal Foetal State

SN	Issues	Root cause	Solution/Intervention
8	Decision on when to deliver not optimised	No formal arrangement for regular updates between O&G and Neonate in both inpatient and out patient settings.	Create inpatient workflow (Weekly inpatient communication between Neonate and O&G) Regular referral to neonate – selective patients (need neonate buy-in)
9	Baby not delivered in optimum conditions	Inadequate joint planning for delivery No formal joint Neonate and O&G morning and exit rounds	High risk deliveries during office hours Daily rounds in DS (9.30am, 6.30pm)



4e. Problem Analysis (PLAN) Paradigm Breaking Exercise

S/n	Why Can't We.....?	Are you able to shift out of this Paradigm?	
		Y	N
1	Screen 100% for risk of PIH / PE	w/ EBD, screen for risk of PIH / PE	
2	Diagnose chorioamnionitis		No established EBD
3	More selective of when to start Dexa (ANS)	w/ EBD start DEXA	
4	Rescue Dexa dose	w/ EBD rescue DEXA dose	
5	OG & Neonates meet weekly	w/ EBD OG & NN meet	
6	Prevent PPROM		Biologically impossible yet
7	High risk cases be discussed between OG & NM Seniors	Morning & evening OG / NN meet in DS	
8	High risk deliveries in office hour	Possible, but not promise	
9	How might we preserve intranterine growth		No EBD
10	Use Actim Partus results for Management	Actim Partus possible w/ EBD	
11	Predict Preterm Delivery	Cervical length screen	
12	Mom's nutrition affects fetus		No EBD
13	Desensitise mom's with Aspirin Allergy	Refer to allergy	
14	Stop giving moms intrapartum O2	EBD / Knowledge	
14A	Delay delivery >24hr post 2nd dose	Possible, no reason why can't delay delivery > 24hrs post 2nd dose	
15	Make GH more effective	Provide training w/ core neonates	
16	Train everyone to be GH member	Core neonates + neonate nurses + consultants	
17	Baby own incubator be place in D/S or OT		Not for now but maybe with new DS
18	Time out for each critical step	Will tighten the t/o process (before treatment)	
19	Standardize transport ventilator use	Use new transport vent machine when arrive in April	
20	Not change linen daily	Talk w/ infection control KIV change every DD	
21	Photo lights in incubator		Not available now
22	Monitor TV during resus	Hamilton; neopuff over ambubag transport use Hamilton to monitor TV	
23	We have regular RT session with Nurses	Will do it once /mth; doctors teaching one /mth	
24	Reduce disconnection	Will tighten lung decruitment awareness	
25	Doctor observe baby more closely when weaning	Possible since doctor is doing it before	
26	Fix ETT for the 1st time	Return demo midline plastering among nurses; Print out GA ETT level. Review NTL bt tut + 6 level	
27	Diagnose RDS early → Give surfactant early	Timepoint of early surfactant rescue; Lung USS in RDS diagnosis	

S/n	Why Can't We.....?	Are you able to shift out of this Paradigm?	
		Y	N
28	Give Lisa instead of insure	w/ EBD give Lisa	
29	Use curosurf instead of infra surf	w/ EPD use curosuft	
30	Predict early BPD	w/ EBD Predict early BPD	
31	Lung u/s for RDS diagnosis	Training for doctors; lung u/s for RDS diag	
32	Standard DAART protocol timing	To be discussed	
33	Histogram renew practice for FIO2	For FIO2 titration	
34	Standardise VG	Protocol existing will review & tighten up; Consider Histogram Epic graph vital signs	
35	Improve nutrition	Yes	
36	Standard weaning & extubation criteria	No standard /EBM for weaning but can give broad guideline	
37	Standard consultant consensus to all practices	Grand ward rounds nurses, dietitian to be involved; Better communication among consultants	
38	Start early NMV rather than CPAP		Conflict NIMV can marked the need for surfactant
39	Have VG titration standard	Review existing V6 + PTV guidelines	
40	Treat all PDA early	Details TBD	
41	Deprong at 34 weeks	Assessment of baby readiness to deprong > 34 weeks onwards	
42	Review A/Bs chart	Possibility of manual chart for (A, B, D)	
43	Vitamin A	To be discussed	
44	Maximise nutrition	Yes	
45	Non-invasive instead of intubation	w/ Lisa Protocol	
46	BPD Bundle protocol	For further discussion	
47	Optimization of caffeine	w/ EBD	
48	Treat ureoplasma infection	Details TBD	
49	Nurses intubate / RT	Doctor to tighten the skills of intubation. RT to be involved. Layers of conflict to be discussed	

5. Interventions & Action Plan (DO) – Best Practices

Expert Invitees from SGH

Best Practices Cross Sharing between SGH & NUH



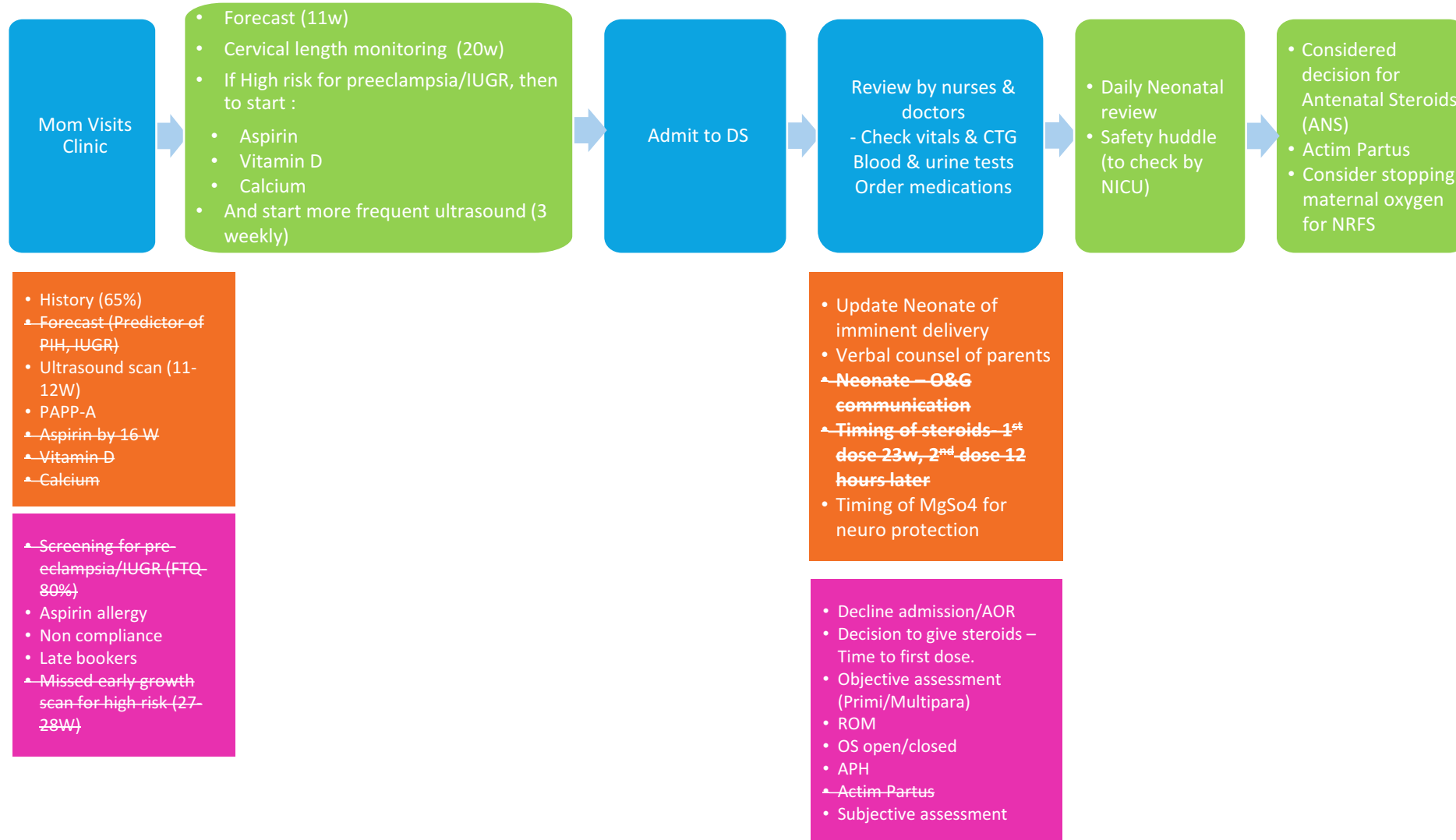
Dr. Poon Woei Bing, Head of Neonatology (SGH)

Dr. Priyantha Edison, Staff Physician (SGH)

All inputs from invitees have been carefully considered and incorporated into the plans



5a. Future Value Stream Maps – Antenatal (1)



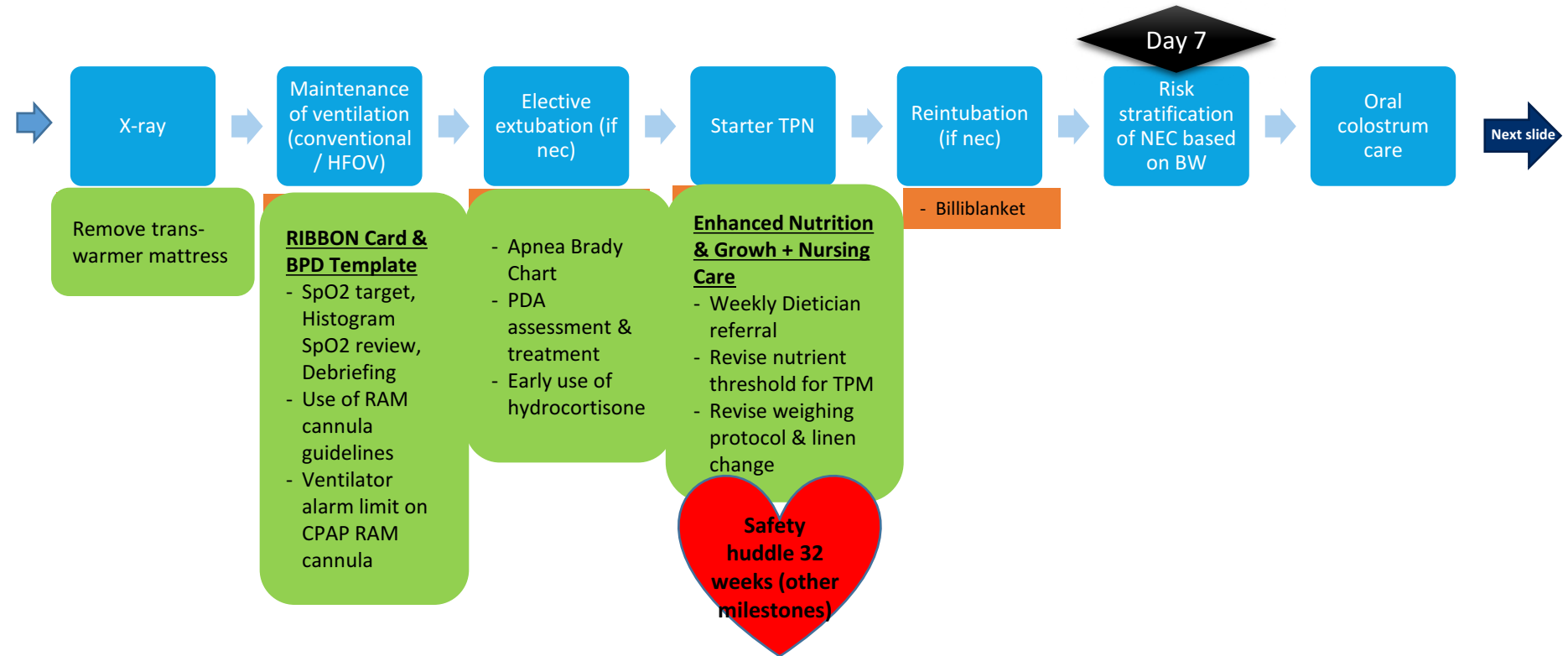
5b. Future Value Stream Maps – Antenatal (2)



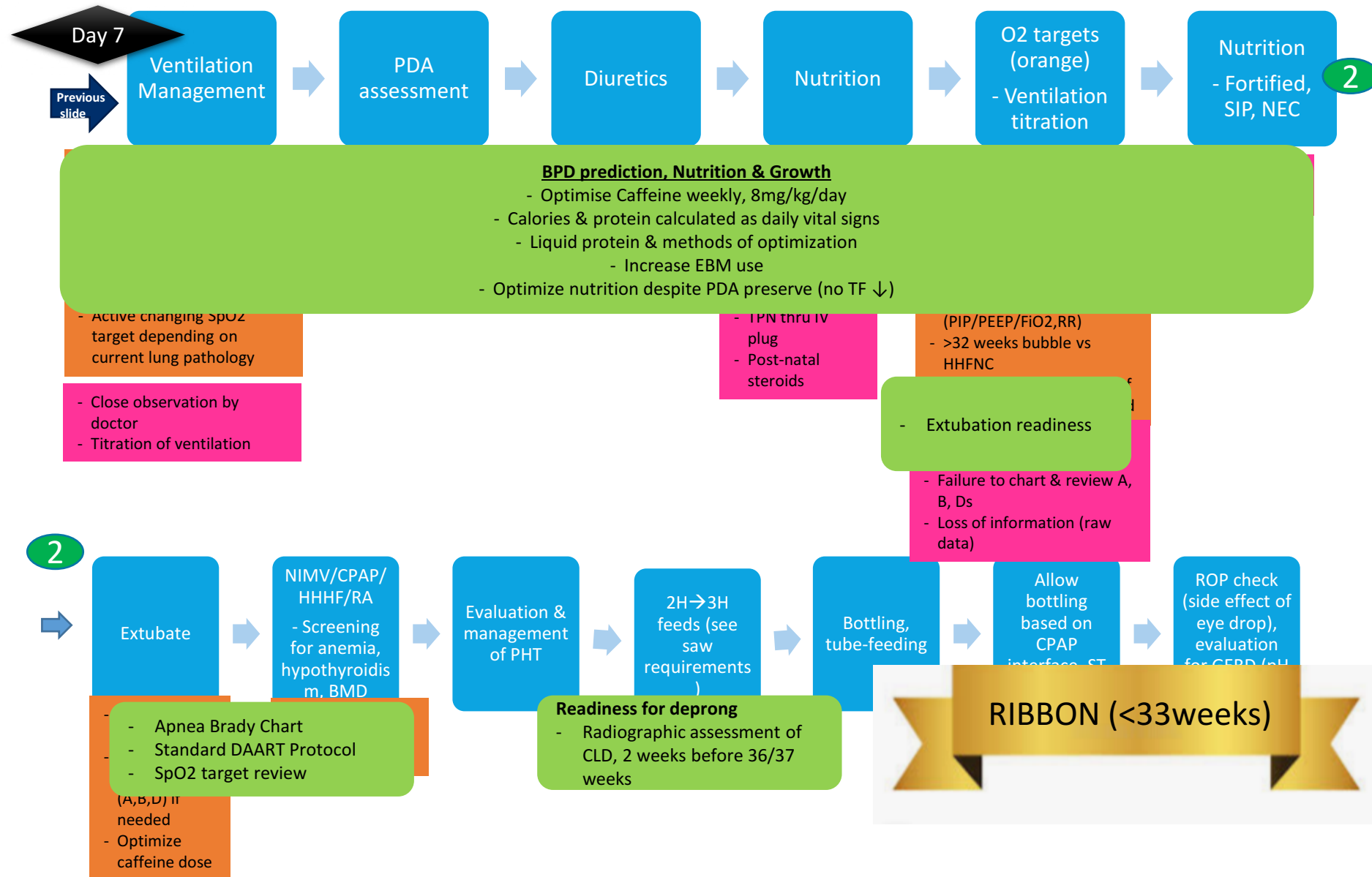
5c. Future Value Stream Map – Birth to 1 Hour of Life (1)



5d. Future Value Stream Map – 1st Hour onwards (2)








5e. Future Value Stream Maps – Week 1 onwards (3)



6. Rapid Experiment and Prototyping

The following standard works were derived during the improvement sprint.

1	Rational antenatal corticosteroid administration	 OG-Antenatal
2	Nutrition proposal	 Nutrition Proposal
3	LISA	 LISA (MIST)
4	Nursing Practice (BPD)	 Nursing Practice - BPD
5	Physiologic Assessment towards cessation of Respiratory Therapy (PART)	 Physiologic Assessment
6	Ribbon Card, Daily Documentation Template, Golden Hour refinements	 Card_Temp_GH
7	Summary of Standard Work	 Summary of Standard Work - Ag

7. Completion Plan

Restricted, Non-Sensitive

[Insert data classification]

7. Completion Plan (phase 1, 30 Apr)

SN	Item	Who	When
1	Enhanced Nutrition Plan	Dr Kalai, Dr Jeanette , dietician, Dr Lee LY	Phase 1 (30 April draft finalized Implement 15 May)
2	Ribbon Card	Dr Khadijah, Sarasvati	Phase 1
3	Ventilation protocol	Dr Agni, Prof Lee, Allelieh	Phase 1
4	Suction protocol	Sister Wang Xia, Illene Chen	Phase 1
5	BPD template	Dr Jeanette, Dr Khadijah, Santosi	Phase 1
6	Finalise Lisa protocol	Dr Agni , Allelieh, Nicole	Phase 1
7	Nursing care	Sister Wang Xia , Melissa, Suhe	Phase 1
8	Golden hour	Dr Khadijah , Dr Kalai, Dr Amutha, Allelieh, Sarasvati	Phase 1
9	Physiologic assessment	Dr Agni, Suhe, Nicole , Allelieh	Phase1

[Insert data classification]

7. Completion Plan (phase 2, May to Jul)

SN	Item	Who	When
10	Antenatal Steroids - Rescue steroids	Dr Pradip , Dr Sarah	Phase 2 (30 June draft finalized-Implement 15 July)
11	O&G – Neonate communication Deck	Dr Pradip , Dr Sarah Sister Siti, Dr Agni	30 June draft finalized Implement 15 July
12	Apnoea chart	Sarasvati, Suhe	30 April draft finalized Implement 15 May
13	GWR nurse rep	Sister Wang Xia, Melissa , Suhe	30 April draft finalized Implement 15 May
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15	Postnatal Steroid protocol	Prof Zubair, Dr Agni , Dr Krish	30 June draft finalized Implement 15 July
16	Lung Ultra sound @1 hour of life	Dr Khadijah , Dr Agni, Dr Mary, Dr Kalai, Dr Shegufta	30 June draft finalized Implement 15 July

[Insert data classification]

7. Completion Plan (Longer term)

SN	Item	Who	When
17	FORECAST (Pre-eclampsia, IUGR, Cervical length) Start Aspirin if indicated De-sensitising aspirin allergy	Dr Pradip , Dr Sarah, Prof Mahesh	To follow-up in 2024
18	Increase trained golden hour pool	Dr Khadijah, Dr Amutha, Sister Wang Xia , Allelieh	To follow-up in 2024
19	Doctor and nurses to be trained on ventilation support	Allelieh , Dr Khadijah, Sarasvati, Dr Agni, Illene	Phase 2 (July)
20	Early BPD prediction	Dr Agni , Dr Khadijah	To follow-up in 2024
21	Vitamin A supplementation	-	To follow-up in 2024
22	Urea plasma screening and treatment	-	To follow-up in 2024
23	1 st Review Meeting (2 weeks post RIE)	All full time members	Physical meeting unless off/shift work - Friday, 31 March, 11.30-1pm (T09-02) Zoom: https://jhis.zoom.us/j/93964749015?pwd=L05Te6980WpYcZxcXBDRz1wWUhzZz09
24	2 nd Review Meeting (2 weeks post RIE)	All full time members	Friday, 14 April, 11-1pm hybrid

[Insert data classification]

7. Results Tracking Plan

SN	What	How	Freq/Period	Who
1	Antenatal corticosteroid Proportion of babies delivered within therapeutic window of ANS	Manual	Quarterly	Dr Pradip Dr Sarah
2	O&G-Neonatology communication Compliance, high-risk delivery in office hours	Manual	Monthly	Dr Pradip Dr Sarah Sister Siti (Sister Zel)
3	LISA: Less Invasive Surfactant Administration Number of intubations prevented, BPD rates, safety and success (based on clinical parameters).	System (Red cap) and manual	Monthly	Nicole Melissa Allelieh Dr Kalai
4	Physiologic assessment Proportion of newborns correctly identified based on their physiology	System (Red cap) and manual	Monthly	Suhe Nicole Dr Agni
5	BPD rate	System (Red cap) and manual	Monthly	Dr Khadijah Dr Agni Sister Wang xia

7. Completion Plan (phase 1, 30 Apr)

SN	Item	Who	When
1	Enhanced Nutrition Plan	Dr Kalai, Dr Jeanette , dietician, Dr Lee LY	Phase 1 (30 April draft finalized Implement 15 May)
2	Ribbon Card	Dr Khadijah, Sarasvati	Phase 1
3	Ventilation protocol	Dr Agni, Prof Lee, Allelieh	Phase 1
4	Suction protocol	Sister Wang Xia, Illene Chen	Phase 1
5	BPD template	Dr Jeanette, Dr Khadijah, Santosi	Phase 1
6	Finalise Lisa protocol	Dr Agni , Allelieh, Nicole	Phase 1
7	Nursing care	Sister Wang Xia , Melissa, Suhe	Phase 1
8	Golden hour	Dr Khadijah , Dr Kalai, Dr Amutha, Allelieh, Sarasvati	Phase 1
9	Physiologic assessment	Dr Agni, Suhe, Nicole , Allelieh	Phase1

7. Completion Plan (phase 2, May to Jul)

SN	Item	Who	When
10	Antenatal Steroids - Rescue steroids	Dr Pradip , Dr Sarah	Phase 2 (30 June draft finalized- Implement 15 July)
11	O&G – Neonate communication Deck	Dr Pradip , Dr Sarah Sister Siti, Dr Agni	30 June draft finalized Implement 15 July
12	Apnoea chart	Sarasvati, Suhe	30 April draft finalized Implement 15 May
13	GWR nurse rep	Sister Wang Xia, Melissa , Suhe	30 April draft finalized Implement 15 May
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18	Increase trained golden hour pool	Dr Khadijah, Dr Amutha, Sister Wang Xia , Allelieh	To follow-up in 2024
19	Doctor and nurses to be trained on ventilation support	Allelieh , Dr Khadijah, Sarasvati, Dr Agni, Illene	Phase 2 (july)
20	Early BPD prediction	Dr Agni , Dr Khadijah	To follow-up in 2024
21	Vitamin A supplementation	-	To follow-up in 2024
22	Urea plasma screening and treatment	-	To follow-up in 2024
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7. Consolidated Solutions (refer to following slides)

REDUCE INCIDENCE OF BABIES WITH BRONCHOPULMONARY DYSPLASIA (RIBBON)

The premature baby's journey in NUH

Jointly by O & G and Neonatal

Work Plans / Interventions

12 weeks Post Menstrual Age (PMA)



36 weeks PMA

ANTENATAL

DELIVERY

EARLY NEONATAL

LATE NEONATAL

FORECAST - REDUCE IUGR

- ANS Optimisation
- Joint Counseling by O & G and Neonatal team
- Management of Chorioamionitis

- Golden hour
- LISA
- Ventilation Strategy
- BPD Nursing Care
- Early Strong Caffeine
- BPD focused documentation and RIBBON card

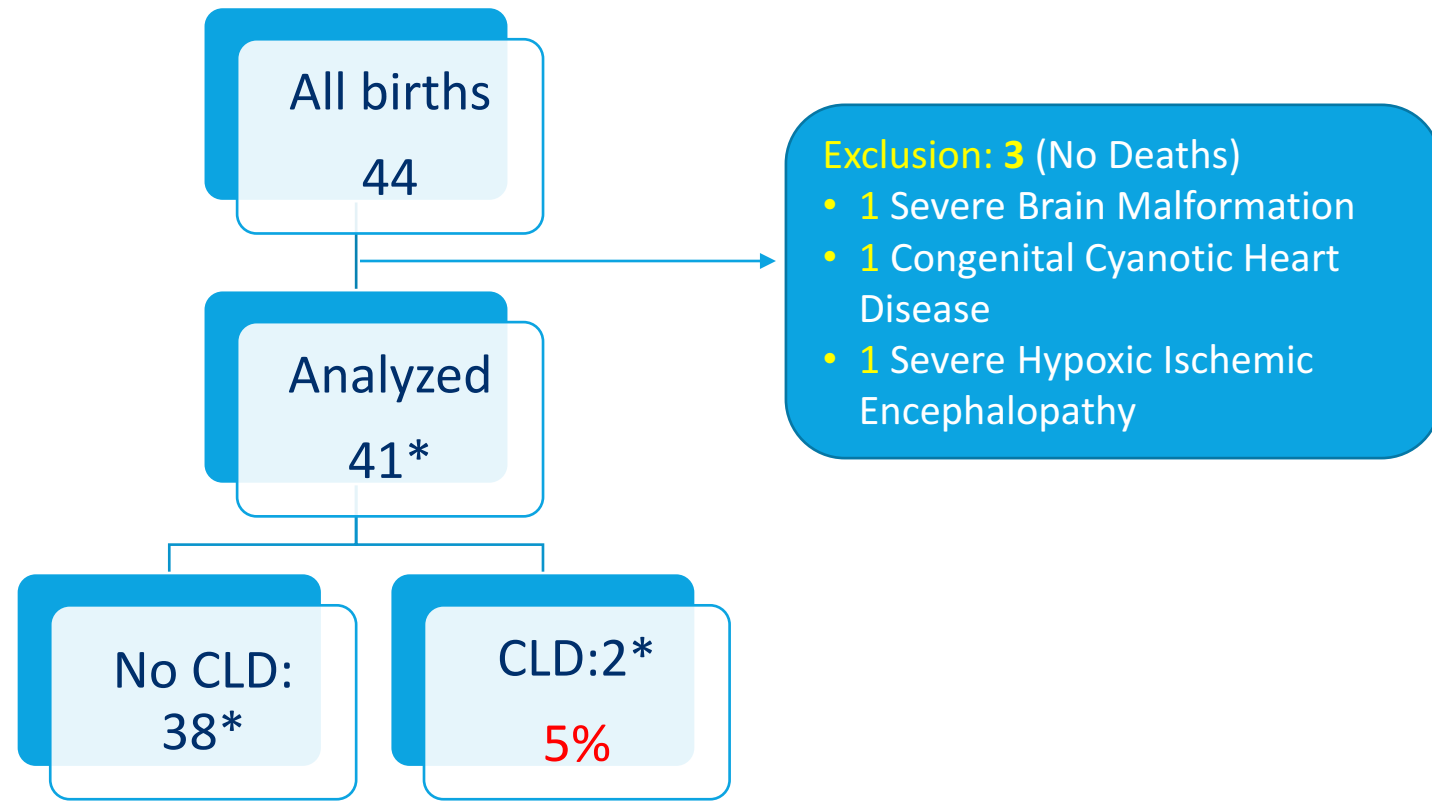
- Nutrition
- Early Extubation
- PDA

- PART

Refer to the following slides for details of the interventions

POST RIE Cohort of Preterms (28⁺⁰- 32⁺⁶ wks)

1st April 2023 - 31st Dec 2023 (Q2,3 &4)



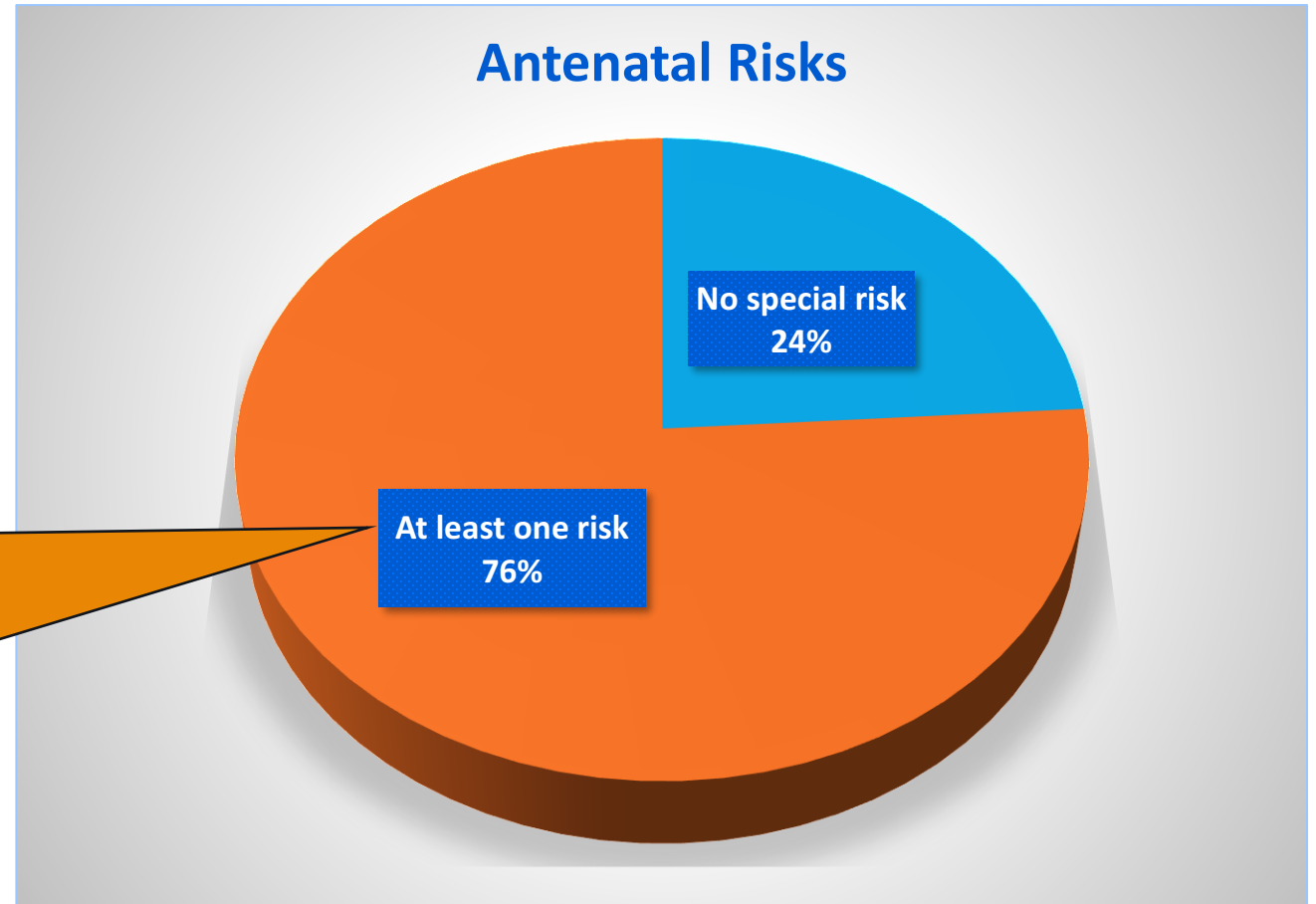
* Analyzed 40 patients for primary outcome: Last patient of the year not yet reached milestone for primary outcome

Antenatal & Perinatal RISKS of the Post Sprint Cohort

(N = 41)

- Conceived as Multifetal pregnancy: 24.4%

- PIH – 22%
- Diabetes – 24%
- Oligohydramnios -10%
- Doppler abnormalities -20%
- PPROM >7 Days – 2%
- Chorioamnionitis – 29%



Obstetric Management of the Antenatal & Perinatal Risks

Aspirin: 100% of eligible mothers received timely Aspirin

Targeted Antenatal Steroids (CBBA excluded):

- 100% coverage with at least 1 dose of ANS
- On target ANS: 74% (post) vs 67% (pre RIE)
- 1 late delivery beyond ANS action

Perinatal antibiotics for Chorioamnionitis:

- 29% of babies born to mums with suspected chorioamnionitis
- 100% coverage with perinatal IV antibiotics in target pop
- None of the babies had early onset sepsis or pneumonia

Neonatal Management of Antenatal & Perinatal Risks

- All non-precipitous deliveries attended by Golden hour team

Delayed cord clamping (> 30 seconds)

- 63% - almost all 60 seconds, one-few minutes
- Reasons for not doing DCC (n=15)
 - Primary apnoea despite stimulation – 40%
 - Abruptio – 20%
 - Nonpulsatile cord – 6%
 - Chorioamnionitis-6%
 - Others: CBBA, Encaul delivery

Temperature management

- Use of multiple resources to preserve thermoneutral environment
- Mean Rectal temp at admission 36.9°C (Median 36.9°C)
 - Adm Temp < 36.0°C : 2.4%
 - Adm Temp < 36.5°C : 17%
 - Adm Temp >37.5°C : 17% (all below 38°C)

Neonatal Management of Antenatal & Perinatal Risks

Day 1

Delivery room respiratory management

- 93% of babies attempted early CPAP/NIMV by prongs
- 7% needed ETT in DR
- Active oxygen management and documentation for all cases
- None of babies on CPAP hypoxic during transfer

Surfactant

- 66% did not require intubation or surfactant
- 34% required at least 1 dose; 15% required 2 or more doses
- All surfactants given within 1 hour of intubation
- Average age of receiving 1st surfactant: 2.5 hrs (Intubation), 2.5hrs (LISA)
- 50% of babies receiving surfactant through ETT extubated by 24 hours
- 92% of babies receiving surfactant through ETT extubated by 72hours

Neonatal Management of Antenatal & Perinatal Risks

Day 1

LISA (Service started 24 Sep 2023)

- 11/14 (79 %) of babies receiving surfactant eligible for LISA
 - LISA successfully performed: 2 babies (both escaped mechanical ventilation)
 - LISA not performed: 9 babies
 - No equipment – 6/9 cases (prior to Sep 2023)
 - Declined consent – 1/9 cases (Religious)
 - Meets Exclusion criteria- 2/9 cases

Caffeine

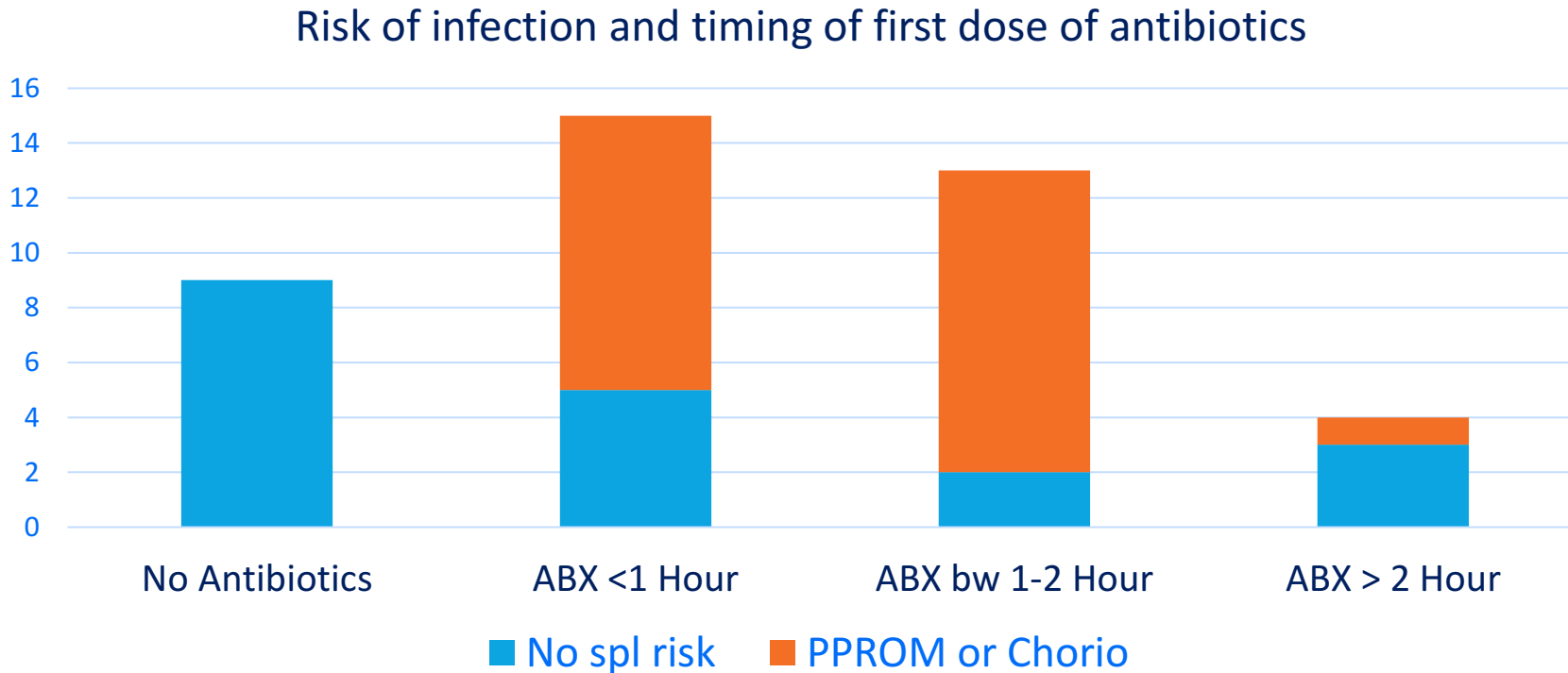
- 98% loaded on Caffeine on D1 – most in first few hours of life

Early parenteral nutrition

- 23 (56%) Did not receive Starter TPN / Early TPN by D1
 - 12 never started (bigger, relatively mature)
 - 11 started in next 48-72 hours

Neonatal Management of Antenatal & Perinatal Risks

Results



70% of babies born to Mum with PPRM or Chorio, had ABX > 1Hour

Antibiotics for babies at risk of early onset infection

- 5/12 (42%) of babies born to a mother with Chorioamnionitis received Antibiotics within 1 hour
- Scope to improve on achieving target of ABX within 1 hour in at-risk babies
- None had culture proven sepsis/ pneumonia

Respiratory Management & Outcome (Pre & Post Sprint)

Characteristics	4yr Pre RIE data (2018-2022); n= 201	April-Dec 2023 (=9 mo); n=41
MANAGEMENT		
Invasive ventilation days, Mean (Med)	2.6 (0)	1.2 (0)
Non Invasive ventilation days, Mean (Med)	23.5 (13)	20.3 (16); n=40*
Oxygen use at 36 weeks	3 (1.5%)	1 (2.4%)
Mean PMA when off Respi support, Mean (Med)	34+4 (33+4)	34+2 (33+3); n=40*
PART utilization for eligible babies	NA	7/7 (100%)
Successfully depronced after PART	NA	5 (71%)
OUTCOMES		
Death before 36 wks	0	0
Death or BPD	42 (20.9%)	2 (5%); n=40*
Grade 3 BPD (Jensen)	1 (0.5%)	0
Grade 2 BPD (Jensen)	41 (20.4%)	2 (5%); n=40*
Grade 1 BPD (Jensen)	0	0

PART: Physiologic assessment towards cessation of respiratory therapy

- 10 babies considered
- 7 eligible
- 5/7 successfully depronced
- Early failure 2 babies (apnoea)

* One patient not reached outcome as yet

How do Babies Who Do Not Receive TPM Fare?

	Received TPN (29)	Did not receive TPN (12)
Mean Gestational age	30+4	32+2
Mean Birth weight, g (z score)	1332 (-0.44)	1872 (0.24)
Mean birth weight percentile	37	53
Time to reach 100 ml/Kg feeds (days)	11.1	6.4
Time to initiate fortification (days)	14.9	8.7
Delta weight Z score (Birth to 35 weeks)	-1.101	-1.336
PMA at discharge	38+4 (n=27)	36+3
Weight Z score at discharge	-1.84 (n=11)	-1.14
Time to regain Birth weight (days)	12.3	17.4

Dietary
intervention after
weaning TPN

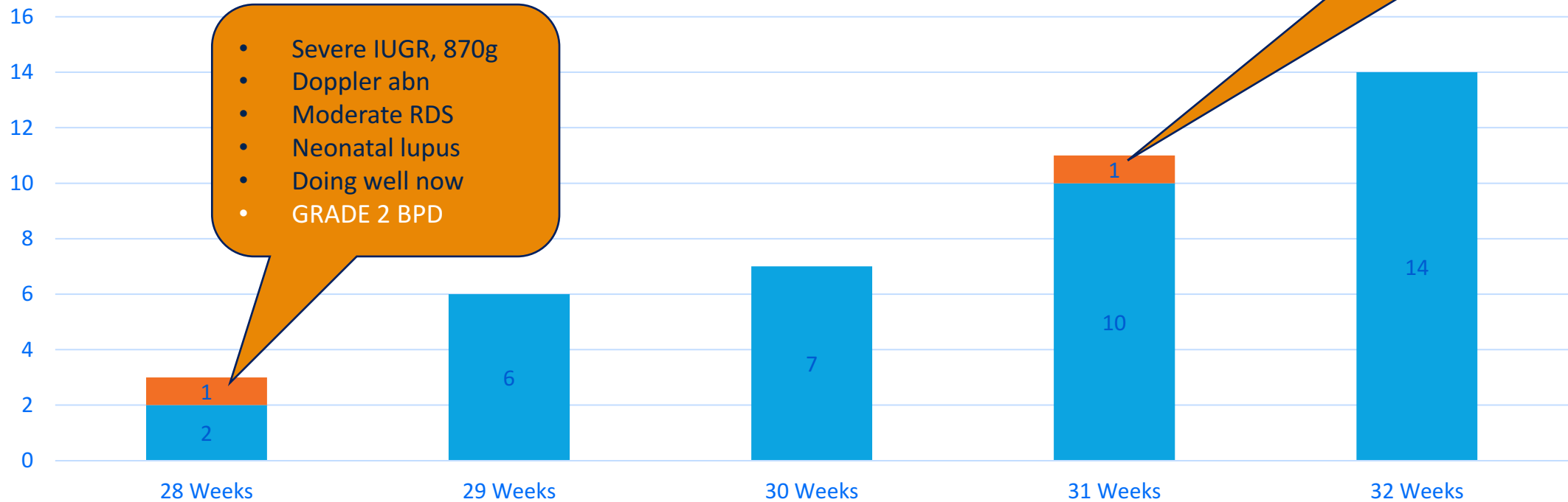
TPN intervention
in early days

8. Confirmed State

Post Implementation from 1st April 2023 to 31 December 2023:
Total 41 babies between 28⁺⁰ – 32⁺⁶ weeks

Pre Sprint CLD rate = 20.9% **Post Sprint CLD rate = 5%**

Patient numbers; n=40*



- Severe IUGR, 870g
- Doppler abn
- Moderate RDS
- Neonatal lupus
- Doing well now
- GRADE 2 BPD

- Severe IUGR, 1050g
- Doppler abn
- Severe RDS
- Mild Pul Hypoplasia
- HFOV, iNO, Steroids
- Doing well now
- GRADE 2 BPD

*1 patient not reached milestone for primary outcome

■ No CLD ■ CLD

9. Insights (Feedback from the team)

What went well?

Brainstorming was superb with excellent ideas	Learnt new concepts	Well-fed with brain food	Big charts with constant easy visibility & excellent facilitation	Well organized
Very high yield output	Every points are taken seriously	Very active participation by all members	Active discussions	Great conversations
Great teamwork!	Open & honest	Team dynamics	Cohesiveness	Respect
Open to change	Cheerful and helpful facilitators (S & S)	Very friendly team	Nice food and very well fed!	

What could be better?

Protected time post RIE	Talk one at a time
Provide water	Time management



Kudos to



RIE Team



Thank you.

